



## Northern California Forests and Watersheds Restoration Strategy

### U.S. Forest Service and National Fish and Wildlife Foundation Partnership

In 2015, the National Fish and Wildlife Foundation (NFWF) established a partnership agreement with the U.S. Forest Service Region 5 (USFS) to strategically invest in conservation projects that benefit watersheds and forest health. This has allowed NFWF to create a Northern California Forests and Watersheds program (Program).

In 2017, the Eldorado and Lassen National Forests dedicated over \$6 million for planning and restoration projects on USFS lands (National Forests) that were affected by the Power Fire and Storrie Fire, respectively. The Power Fire and Storrie Fire funds will be used exclusively for the Eldorado and Lassen National Forests watersheds that were directly affected or have a nexus to the fire as noted in this focused restoration strategy and future request for proposals.

As NFWF manages other federal and non-federal funds, any other dollars not dedicated to the Power and Storrie Fires for the Program can be used on projects that benefit forest health such as meadow restoration, fuels reduction, and improving habitat for species such as the California spotted owl throughout the Northern California forest geography. Those additional funds will also be administered in this partnership and, when necessary, can also be used on the Power and Storrie Fire watersheds depending on funding source restrictions. However, the Power and Storrie Fire funds cannot be used in other geographies. As such, this program will include National Forests, watersheds, and partners within the Program's Northern California geographic focus. The region includes eleven National Forests: Eldorado, Klamath, Lake Tahoe Basin Management Unit, Lassen, Mendocino, Modoc, Plumas, Shasta-Trinity, Six Rivers, Stanislaus, and Tahoe (Figure 1). In addition, NFWF will continue to administer its Sierra Nevada Meadows funding throughout the Sierra Nevada meadows range through this Program. The Sierra Nevada meadows range includes twelve National Forests: Eldorado, Humboldt-Toiyabe, Inyo, Lake Tahoe Basin Management Unit, Lassen, Modoc, Plumas, Sequoia, Shasta-Trinity, Sierra, Stanislaus, and Tahoe (Figure 2).

The Northern California Forests and Watersheds Restoration Strategy (Restoration Strategy) serves as the guiding document to aid USFS, NFWF, and our partners in focusing, and ultimately implementing, projects that strategically, and prescriptively, advance restoration and post-fire restoration on a larger landscape and watershed level. The Restoration Strategy outlines the Program's goals and objectives for forest and watershed restoration, and highlights potential actions toward reaching those goals. Additionally, working with our tribal partners will be a key priority as the Program also focuses on cultural and tribal resources restoration and protection. Focus areas described within this document will be targeted in the initial phases of planning and restoration; however projects outside of these areas may be considered depending on future funding sources and alignment with the strategic goals of the Program. Revisions to the Restoration Strategy may be made as additional information is gathered and project success is evaluated. The Restoration Strategy is a precursor to a Northern California Forests and Watersheds (Northern California) business plan. The strategies incorporated within this Restoration Strategy may be modified, expanded, or removed, depending on the additional scientific review lessons learned while developing the Northern California business plan.



Figure 1. Northern California Forests and Watersheds program geography

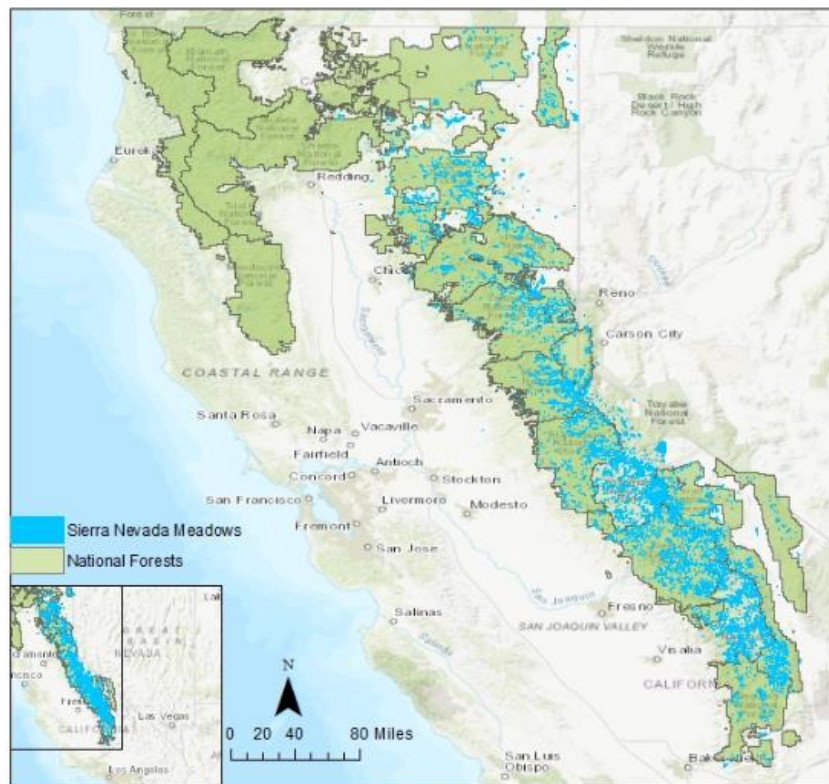


Figure 2. California National Forests and Sierra Nevada meadows ([Sierra Nevada Meadows Data Clearinghouse](#)).

## Significance of Northern California's Forests and Watersheds

Combined, the National Forests for this Program account for over 15.1 million acres, overlaps with over 250 watersheds and 13 major rivers, and stretches across 26 counties and five Congressional districts (Figure 1). Just a few hours away from neighboring communities, these National Forests host millions of visitors who come to explore a variety of landscapes including lava tubes, meadows, chaparral, subalpine, mountains, and numerous lakes, streams, and rivers. In addition to recreation activities, nearly 7,000 visitors enjoy climbing Mt. Shasta, the fifth highest peak in California, and contribute over \$168,000 in Shasta-Trinity National Forest permit fees (USFS 2017a). The Pacific Crest Trail spans from Canada to Mexico and has issued over 5,600 long distance permits and hosted countless short distance hikers (PCTA 2016). Combined, all of California's National Forests generates nearly \$140 million in timber and biomass value every year. All of California's National Forests' water, timber, and recreation opportunities have a total value worth \$13 billion (USFS 2017b).

Although California's National Forests comprise only 20% of the area in the state, the forests provide nearly half of the state's high quality water supply worth \$9.5 billion annually (USFS 2017b). Additionally, there are over 750 miles of rivers in northern California that are designated in the National Wild and Scenic Rivers System, which demonstrates the outstanding natural, cultural, and recreation values in a free-flowing condition that should be preserved. Northern California is also home to Smith River, which is California's only major free flowing river.

This northern California landscape is also home to over 300 species of wildlife, including the California spotted owl, endangered marbled murrelet, threatened Northern spotted owl, bald eagle, Pacific marten, Sierra Nevada yellow-legged frog, and numerous endangered and threatened species. Furthermore, the Sierra Nevada meadows are a key habitat for endemic species such as the endangered Sierra Nevada yellow-legged frog, endangered Mountain yellow-legged frog, threatened Yosemite toad, and threatened Lahontan cutthroat trout. Of particular importance, the Sierra Nevada supplies over 60% of California's water supply which supports the country's largest agricultural economy, commercial fishing, and its millions of residents.

## Chapter 1 - Wildfire Impacts on California Forests and Sierra Nevada Meadows Restoration

### Wildfire and U.S. Forest Service's California Forests

The National Forests of northern California occur within a Mediterranean to an alpine climate. Periodic wildfire is a natural and important part of the ecological processes of the region. However, the threat of intense unnatural wildfire has increased due to decades of fire suppression activities, recent droughts and beetle killed trees, and the challenges from increased human ignitions associated with population growth and increasing use of the forest. As noted by USFS and other agency fire specialists, "The challenge today is to develop fire policies, management actions, and budgets that recognize the need for both fire suppression and the management of fire as an ecosystem process and hazard reduction tool." (Sugihara et al 2006).

In California, 11 of the state's largest 20 wildfires have occurred within the last 10 years. Although the ecosystems of northern California have evolved to be well adapted to fire, the stressors associated with

recent increases in intensity of fires have resulted in long-term losses in habitat, ecosystem transitions, opportunities for invasive species to take hold and spread, and changes in hydrology and associated effects to sediment and nutrient fate and transport. In addition, communities adjacent to National Forest boundaries share the risks of wildfire, and forest managers are challenged to provide safe environments for those within and adjacent to the forest.

### Storrie Fire – Lassen National Forest

In 2000, the Storrie Fire burned over 56,000 acres on the Lassen and Plumas National Forests and adjacent private lands. The Lassen National Forest's burned area included 27,000 acres primarily within Lower Yellow Creek and Chips Creek watersheds (Figure 3). The Middle North Fork Feather River watershed encompasses the Chips Creek, Rock Creek, and Milk Ranch Creek-North Fork Feather River watersheds, and has riparian habitat and biodiversity that is key for the endangered Sierra Nevada yellow-legged frog, and other sensitive species. The North Fork Feather River watershed also has Designated Critical Habitat for the Sierra Nevada yellow-legged frog. The Storrie Fire also burned habitat used by the California spotted owl and Pacific marten.

The watersheds of the Storrie Fire burn scar on the Lassen National Forest contains several features of USFS and public interest. Some of which include:

- The Green Island Lake Research Natural Area (RNA) – The Green Island Lake RNA is one of eight RNAs located in Lassen National Forest. The RNA program is a nationwide system created to protect and maintain biological diversity, provide ecological baseline information, and support research and natural-history education on federal lands. In particular, Green Island Lake RNA was chosen due to its unique moss bogs. The RNA is also home to the northern goshawk, and chaparral and alder riparian habitat (Fiedler 1986).
- The North Fork Feather River - The North Fork Feather River watershed provides drinking water that is critical to downstream users. The North Fork Feather River is a principal tributary that drains part of the northern Sierra Nevada and Southern Cascades and contributes to the Sacramento River.
- The Pacific Crest Trail - The famous 2,650 mile hiking trail Pacific Crest Trail runs from Canada to Mexico, and has 15 miles of its trail within the Storrie Fire boundary. The Pacific Crest Trail contributes to the local economy and tourism due to a variety of local, domestic, and international visitors from over 40 countries and territories. In 2016, there has been an overall increase for visiting the trail as evidenced by the 5,657 long distance permits issued in 2016, which is a 30% increase over the past three years (PCTA 2016).

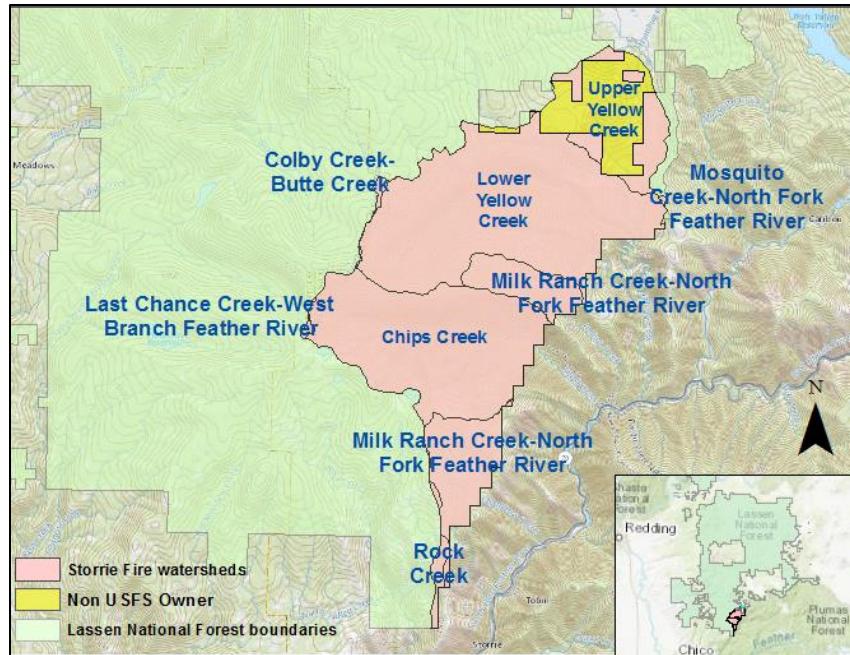


Figure 3. Lassen National Forest’s map of the Storrie Fire’s impacted and nexus watersheds.

### Power Fire – Eldorado National Forest

In 2004, the Power Fire burned nearly 17,000 acres on the Eldorado National Forest and adjacent private timberlands. The fire occurred within Amador County, which also borders Calaveras County. Eldorado National Forest’s burned area included 14,000 acres of predominantly old growth forest and perennial and seasonal streams within the Bear River, Cole Creek, Salt Springs Reservoir, Tiger Creek, and Panther Creek watersheds (Figure 4). Nearly 50% of the Power Fire area burned at high intensity, which resulted in killing 75-100% of the trees and burning the plant litter that protects the soil. In the high and moderate intensity areas, the Power Fire resulted in high rates of soil erosion, elevated stream temperatures, increased stream sedimentation, and loss of old forest habitat for sensitive species. The fire scar also encompassed meadows, springs, and waterholes within the USFS’s greater Collaborative Forest Landscape Restoration (CFLR) Cornerstone Project. CFLR will focus on the Cat Creek-Middle Fork Cosumnes River and Sopiago Creek-Middle Fork Cosumnes River watersheds (Figure 4).

The Power Fire’s range affected multiple watershed and forest species such as the endangered Sierra Nevada yellow-legged frog and USFS sensitive Foothill yellow-legged frog and northern goshawk. In particular, the fire had a large impact on California spotted owl protected activity center (PAC) habitat with one of the nine PACs being removed from a California spotted owl habitat list and four PACs being removed from a critical list of over 1,000 acres of contiguous California spotted owl habitat list (Loffland 2007).

Beyond ecological impacts, there were also human and economic consequences due to the fire. The Power Fire consumed over \$59 million of economically viable timber on public and private land (calculated from USDA 2012). The fire also degraded aquatic habitat and affected the watershed in the North Fork Mokelumne River, which has eligible qualities for National Wild and Scenic River protection. The Mokelumne River watershed is also a key source of water for East Bay Municipal Utility District’s (EBMUD) 1.3 million customers in Alameda and Contra Costa Counties. The Power Fire also occurred adjacent to the Salt Springs Reservoir which is sourced from Pacific Gas and Electric’s Salt Springs Dam

on the North Fork of the Mokelumne River.

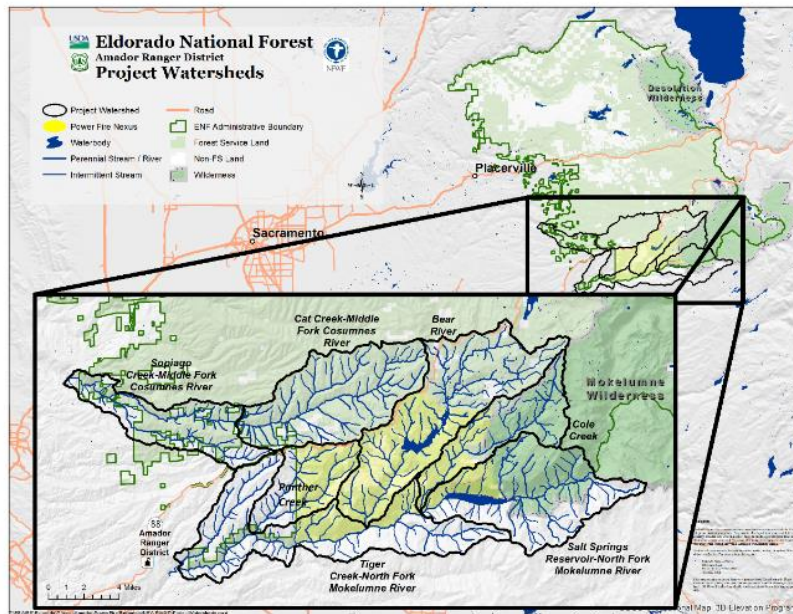


Figure 4. Eldorado National Forest’s map of the Power Fire’s impacted, nexus, and CFLR watersheds.

## Northern California Forests and Watersheds Restoration Goals and Priorities

The Program aims to increase the pace and scale of strategic restoration on northern California National Forests. The proposed conservation outcomes of this Program are informed by the USDA Forest Service Strategic Plan (USDA 2015), which identifies two main goals:

- 1) Restore, sustain, and enhance the nation’s forests and grasslands by fostering resilient, adaptive ecosystems to mitigate climate change; through strategic land management, mitigating wildfire risk, and conserving open space; and,
- 2) Deliver and sustain the benefits of the National Forests to the American public by providing abundant clean water, strengthening communities, and connecting people to the outdoors. California’s National Forests goals are further described and expanded upon within USFS’s Ecological Restoration Implementation Plan, and in particular, Chapter 1 - Region 5 Ecological Restoration Leadership Intent, Chapter 2 – Overarching Strategies, and Chapter 3 – National Forest Ecological Restoration Implementation Plan [per National Forest] (USDA 2013).

The Watershed Condition Classification (WCC) is a standardized method used by USFS to evaluate and rate the health and function of watersheds on a number of different attributes (Appendix A). Initial prioritization of watersheds and their related needs may be guided by the available WCC information for each National Forest (USFS 2017c). The watersheds directly impacted by the fires addressed through this Program are referenced earlier in Figures 3 and 4. Watershed Condition Classification information for these fire affected watersheds is also available (Appendix B).

### *Northern California Forests and Watersheds Restoration Geographic Priorities*

The purpose of this Program is to restore ecological integrity and healthy functioning of watersheds and ecosystems affected by the Storrie and Power Fires. The Lassen and Eldorado National Forests, in conjunction with NFWF, have identified these watersheds as primary focal areas in order to maximize available resources and achieve the highest possible conservation outcomes.

Lassen National Forest's Priority Watersheds (Figure 5):

- 1) Chips Creek
- 2) Upper Yellow Creek
- 3) Lower Yellow Creek

Eldorado National Forest's Priority Watersheds (Figure 6):

- 1) Panther Creek
- 2) Bear River
- 3) Cole Creek

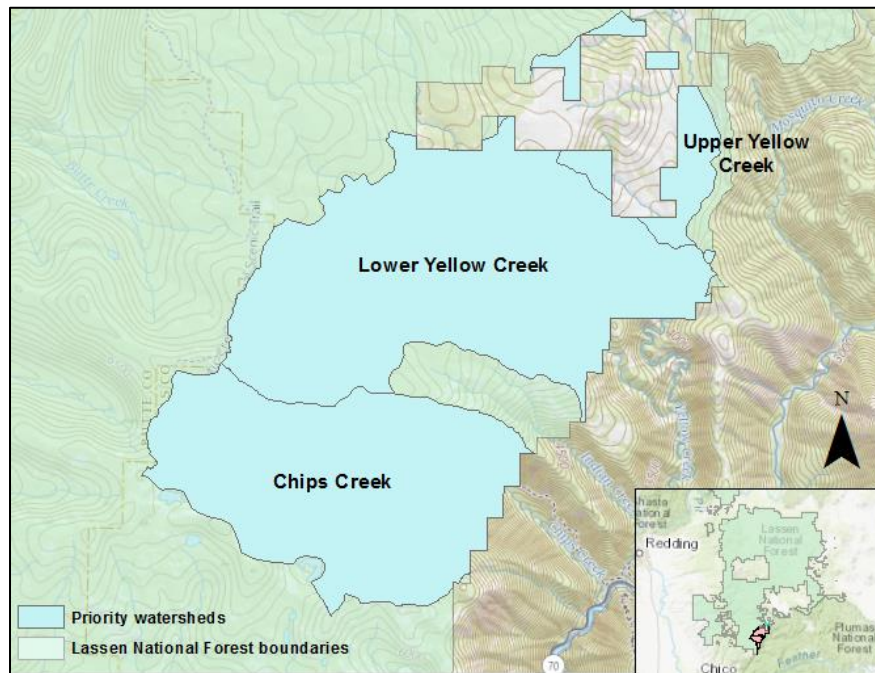


Figure 5. Lassen National Forest's Power Fire priority watersheds map.

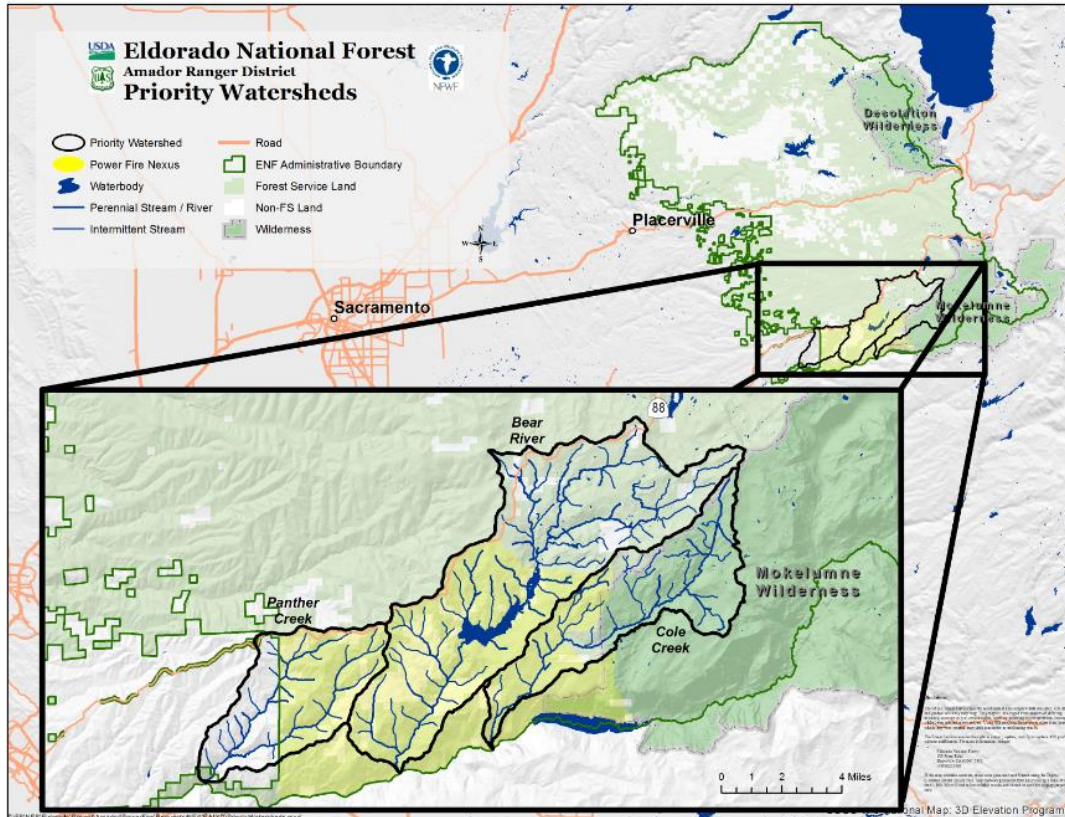


Figure 6. Eldorado National Forest's Power Fire priority watersheds map.

Establishing a clear conservation strategy to restore these focus areas will improve forest health on a larger scale as opposed to individual non-contiguous segments. Areas outside of these focal areas are also eligible for funding provided the applicant demonstrates a clear nexus to addressing the needs resulting from the Storrie and Power Fires.

### *Northern California Forests and Watersheds Restoration Priorities – A Guide to NFWF Funding*

The USFS and NFWF seek to implement a strategic watershed-scale approach to restoration in this region. The initial restoration activities to be completed through this Program are primarily supported through fire cost recovery settlement funds that are designated to address the impacts and concerns related to their respective fires. In order to achieve Program goals while operating within the constraints of existing and future funding sources, a variety of separate but complementary strategies and associated activities may be implemented. Some of the Program's highest priority activities include but are not limited to:

- **Watershed/Aquatic Organism Passage (AOP) Restoration**
  - Site prioritization analysis with restoration recommendations
  - Design planning and watershed/stream assessments e.g.: sedimentation, hydrology, invasive species, vegetation, wildlife, and fish
  - Implementation of AOP removal/restoration projects and NEPA completion
- **Landscape Level Restoration**
  - Site prioritization analysis with restoration recommendations



- Design planning for habitats such as forests, fens, meadows, wetlands, riparian, and grasslands, with assessments e.g.: sedimentation, hydrology, watershed, invasive species, vegetation, wildlife, fish, and archaeology
- Implementation of landscape restoration projects and NEPA completion
- **Meadow Restoration**
  - Site prioritization analysis with restoration recommendations
  - Design planning and assessments e.g.: sedimentation, hydrology, watershed, invasive species, vegetation, wildlife, and archaeology
  - Implementation of meadow restoration projects and NEPA completion
- **Native Species Restoration and Non-Native Species Control**
  - Site prioritization analysis with restoration recommendations
  - Design planning and assessments to enhance native species and reduce access and prevalence of non-native species
  - Implementation of native species restoration and non-native species control projects and NEPA completion
- **Fuels Management**
  - Site prioritization analysis with restoration recommendations
  - Design planning and assessments e.g.: vegetation, tree stock cover, snag counts, archaeology, sedimentation, and wildlife
  - Implementation of fuels management projects and NEPA completion
- **Recreational Use Management of Trails, Roads, and Campsites**
  - Site prioritization analysis with restoration recommendations
  - Design planning for creation, maintenance, and enhancement control, with assessments e.g.: hydrology, sedimentation, vegetation, wildlife, and archaeology
  - Implementation of recreational use management projects and NEPA completion

While the identified priorities above highlight some of the most pressing watershed needs for the Program, the following section describes a full range of strategies and recommendations that may be employed as appropriate. As more information is gathered over time, these strategies may be refined to increase success and effectiveness of the Program.

### Strategy 1. Assessment, Prioritization, and Planning

Assessment, prioritization, and planning is a critical first step in addressing Program goals. This helps increase conservation outcomes and the return on investment into the landscape. Information regarding forest health and watershed conditions may be incomplete or outdated due to recent fires or other landscape changes. In order to develop strategic and effective restoration and conservation projects, relevant information must be gathered to focus opportunities to areas of greatest need, determine the best techniques to employ given site conditions and restoration goals, comply with regulatory requirements, and evaluate project effectiveness over time.

NFWF worked with Eldorado and Lassen National Forests to provide an initial assessment of the current state of the Power and Storrie Fire restoration activities with a goal of categorizing and ultimately prioritizing restoration activities. Through those efforts we have developed this Restoration Strategy

which summarizes each forest's watershed restoration activities and needs within the watershed of the fire scars. Additionally, Eldorado and Lassen National Forests have identified priority watersheds and conservation activities that will allow us to achieve the highest possible conservation return on investment. NFWF will utilize existing scientific and modeling resources to help identify the restoration activities most likely to succeed over the long-term based on the changing environmental conditions using each forest's priority watershed map and WCC data (Figure 5 and 6, and Appendix B).

Where necessary, and implementation projects are not ready, NFWF and USFS have identified individual projects that can be supported in future Program Request for Proposals (RFPs). The types of assessment, prioritization, and planning activities that may be conducted to address watershed needs are broadly identified in the following strategies by NOAA's Ecosystem Processes research team (adapted from Roni and Beechie, 2012):

- **Watershed-scale process assessment** – Assess effects of changing land cover and vegetation types on runoff and stream flows, erosion processes, nutrient supply to streams, and the implications on ecosystems and natural communities.
- **Reach-scale process assessment** – Assess riparian conditions, alterations of stream flow by dams or diversions, sediment transport and storage, and floodplain habitats.
- **Habitat alterations assessment** – Evaluate condition of habitat features relative to expected natural conditions or reference conditions, identify fish passage barriers, and assess water quality.
- **Changes to biota** – Evaluate status of priority populations or species, ecosystem assemblages, and presence, abundances, and impacts of non-native species.
- **Regulatory compliance and approval** – Develop analysis and reports for compliance with regulatory policies such as the Endangered Species Act, Wilderness Act, Wild and Scenic Rivers Act, and National Trails System Act.

The watersheds directly impacted by the fires addressed through this Program are referenced in Figures 3 and 4. Watershed Condition Classification information for those fire affected watersheds is also available (Appendix B).

In addition, NFWF has established business plans that will guide our investments in this region, particularly focusing on Sierra Nevada meadow restoration and Lahontan cutthroat trout (LCT) benefits.

- The recently exited Sierra Nevada meadows business plan can be found at: [www.nfwf.org/sierranevada/Documents/Sierra\\_Meadow\\_Restoration\\_business\\_plan.pdf](http://www.nfwf.org/sierranevada/Documents/Sierra_Meadow_Restoration_business_plan.pdf)
- The Lahontan cutthroat trout business plan can be found at: [www.nfwf.org/lct/Documents/lct-business-plan.pdf](http://www.nfwf.org/lct/Documents/lct-business-plan.pdf)

## Strategy 2. Forest and Upland Restoration and Management

Activities under this strategy refer largely to implementation work designed to improve or sustain terrestrial environments. Projects may be developed at a broad scale to restore ecosystems such as forest stands or grasslands. However, depending on the locations most impacted by the fires, projects may be prioritized to directly focus on the recovery of individual species important to forest health.

- **Seed collection and propagation** - Changes in fire regime, including increased intensity or frequency, may decimate standing vegetation and the seed bank within the soil. As high intensity fires become more frequent, burned landscapes become more susceptible to converting from diverse native vegetation communities to monocultures dominated by invasive plants. Seed collection and propagation is therefore important to ensuring restoration with locally adapted species.
- **Native vegetation replanting and management** - In order to restore forest and upland environments, replanting native species where native vegetation communities once existed may be necessary where natural recovery processes have been delayed or altered as a result of wildfire or other stressors. Native vegetation management, including revegetation, will be especially critical at fuel breaks and other areas that have been recently treated. Vegetation communities of particular native vegetation management interest include aspen and black oak.
- **Invasive species eradication** - A number of species of invasive plants have established a presence on National Forests and pose a threat to native plant communities and the fish and wildlife species they support. These threats can be manifested in a variety of ways: changing soil fertility and stability, increasing fire return intervals, altering habitat needed by other native animal species, and decreasing water availability. Where possible, implementation of control measures to remove invasive species should be conducted. Performing an additional round of invasive eradication and monitoring will be especially critical at reforested, fuel breaks, and other areas that have been recently treated.
- **Fuels reduction management** – Fuels reduction mechanisms such as prescribed burns, biomass removal, or forest stand thinning may help some areas replicate the natural process of wildfire. Natural wildfire benefits includes reducing fuels, removing competitive invasive species, promoting germination of fire adapted species, and increasing diversity and age structure in vegetative environments. Prescribed burns, biomass removal, or thinning may have particular applications in maintaining riparian corridor and aspen regeneration. Fuels management can help reduce tree and leaf litter buildup thereby decreasing the potential amount of wildfire habitat damage. Additionally, fuels management can decrease the amount of potential debris and sediment run-off that enters headwaters due to a wildfire. Furthermore, the technique could also increase the potential for protecting habitat critical to the survival of the California spotted owl (USFS 2017d).

### Strategy 3. Watershed Restoration and Management

Approaches described under this strategy refer to restoration of aquatic environments and the species they support, such as willow flycatcher, Lahontan cutthroat trout, and Sierra Nevada yellow-legged frog. Aquatic environments include watersheds, meadows, riparian corridors, streams, and fens. Where needed, project activities will be guided by the assessment, prioritization, and planning described in Strategy 1 to ensure Program goals and priorities are appropriately incorporated.

- **Watershed, meadow, fen, and riparian corridor restoration** – Watersheds, meadows, fens, riparian corridors provide a number of ecosystem functions that support both upland and aquatic environments. Streamside vegetation buffers pollutants from waterways, contributes shade and habitat structure for both aquatic and terrestrial species, ameliorates fluctuations in

water temperature, reduces instream water temperature, stabilizes stream channel form and function, and can help slow or halt advancing wildfire. However, the loss of meadow and riparian vegetation, and the conversion of meadow and riparian systems from native vegetation to primarily invasive vegetation can alter and degrade these functions in ways that have lasting impact across the landscape. Meadows and riparian corridors will be assessed and restored, where appropriate, to help maintain healthy watersheds and support species such as willow flycatcher, Lahontan cutthroat trout, and Sierra Nevada yellow-legged frog. Fencing may need to be considered as an option in order to keep out non-native species from sensitive watersheds segments, meadows, fens, and riparian habitats. Using fencing strategically may help native vegetation and habitats experience reduced impacts.

- **Aquatic organism passage improvements** - Aquatic organism passage barriers affect some aquatic species by obstructing their distribution and range, reducing available habitat, threatening genetic diversity by isolating populations, increasing the risks from predation and competition, and water quality and quantity impacts. These impacts can be exacerbated even further with increases in pollutant loads and altered habitat after wildfire or other events. Activities may include modifying road, stream, and trail crossings to allow unimpeded natural flow such as replacing culverts with a free span bridge, or installing fish ladders or other engineered solutions for fish or other aquatic species to traverse barriers.
- **Instream habitat restoration** - Sediment and debris that enters stream channels and floodplains may dramatically modify the type and distribution of in-stream habitats throughout the stream network. These impacts may be magnified when anthropogenic influences that modify the flow regime and prohibit the natural movement of sediment and other inputs through the system. Instream habitat restoration may include removing or modifying features to enhance downstream sediment transport, restoring floodplain connectivity to streams to disperse sediment from channels, and re-establishing habitat types necessary for various life-cycle stages of aquatic organisms that have been eliminated or diminished as a result of wildfire or other events.
- **Instream flow restoration** - Wildfire may have ramifications to local hydrology, particularly in the meadow and mountain region where over half of California's water supply originates. Changes in soil infiltration rates, evapotranspiration, and overland flows and pathways may all be impacted by post-wildfire events, which can lead to changes in the quantity and timing of instream flows. These changes may in turn directly affect aquatic species that are flow- and habitat-dependent to reach all life history stages. In addition, changes in hydrology have implications for the supply and management of water for human populations that rely on local sources of surface and groundwater. Where these hydrologic alterations are identified and understood, efforts should be made to recover instream flows to conditions supportive of aquatic and riparian species that exist in affected streams. Therefore, instream flow restoration projects may include but are not limited to projects such as meadow restoration, channel or hydrologic modifications, and debris removal or abatement.
- **Invasive species eradication** - As with the forest and upland environments, aquatic invasive plant and animal species have established a presence in USFS waterways that threaten the success of native populations. Invasive species may displace, outcompete, or prey on native species and disrupt the ecology of the aquatic and riparian environments. Aquatic invasive plants may affect water availability, nutrient cycling, sediment storage, and flow and flood

dynamics. Activities may include removing aquatic vegetation through hand-pulling and mechanical treatment, and localized herbicide application. In the case of invasive species such as crayfish, eradication may be completed through systematic surveys of the aquatic systems followed by selective capture and eradication.

#### Strategy 4. Species Specific Strategies

Northern California forests and watersheds support numerous federally threatened and endangered species, and USFS sensitive plants and animals. Many of the activities identified in Strategies 1, 2, and 3 indirectly influence the restoration and conservation of these species, or are designed to increase species populations and/or habitat. Where appropriate, projects designed to specifically address species of particular interest occurring within the Program's geographic boundaries may be utilized. Some of the priority species of interest include: California spotted owl, Pacific fisher, and Pacific marten. Additional priority species of interest per each forest can also be addressed (Appendix C).

#### Strategy 5. Recreational and Non-natural Features Management

Management of recreational and non-natural features such as trails, roads, campsites, and fuel breaks play an important role in maintaining healthy landscapes. These features provide critical pathways that allow USFS personnel and other resource managers' critical access to the forest. They also provide an opportunity to connect people with the outdoors and foster appreciation of the natural environment. However, unmaintained and damaged trails, roads, campsites, and fuel breaks may exacerbate natural resource challenges by acting as conduits of sediment, invasive species and other impacts. Degraded infrastructure and burned landscapes may also lead to users creating their own unauthorized off-trail routes, which further impact the lands, increase pollutant sources, and provide new opportunity for the introduction of invasive species. Restoring these features to USFS standards therefore provides multiple benefits to ecosystem restoration and facilitating use and appreciation of public lands.

- **Field condition assessments and management recommendations** – Gather information to strategically identify critical trails, roads, campsites, or fuel breaks in need of restoration and improvement related to the Program's goals. Comprehensive field condition assessments and management recommendations such as re-routing areas or efforts needed to maintain an area may be necessary.
- **Trail system management** – Management techniques may include maintenance, re-routing, or improvement of USFS system trails. There is a project preference for forest trails that currently reduce forest or watershed health, forest management capabilities, or forest use.
- **Forest road system management** - Management techniques may include maintenance or improvement of USFS roads. There is a project preference for forest roads with critical locations that have chronic erosion and increased sediment loading to watersheds, habitat, or other natural features of the forest.
- **Campsite system management** - Management techniques may include maintenance, relocation, creation, or improvement of USFS campsites. Illegal campsites created by users may also have illegal trails that together contribute to chronic erosion and increased sediment loading to watersheds, habitat, or other natural features of the forest.

- **Fuel break system management** - Management techniques may include recovery of fuel breaks, biomass removal, maintenance of critical fuel breaks, and incorporating invasive species removal and revegetation projects. Fuel break projects will be considered as long as they include mitigation to meet other ecological goals, and are critical for future forest health and fire management.

## Measuring Program Performance

This Restoration Strategy is intended to direct actions that result in measureable and beneficial improvement of the resource, and contribute to the goals of the Program. Projects completed through this Program will be required to quantify outcomes that align with the identified priorities. As part of this Program, preliminary metrics have been identified to assist restoration toward those outcomes. The quantifiable metrics developed for ecological restoration are presented below. These measures may be expanded or improved upon as additional assessment work is completed and priorities are further evaluated.

### Program performance metrics

- Number of aquatic organism passage barriers improved
- Miles of stream re-connected or improved
- Acres of riparian, land, and meadow habitat improved
- Acres of restored hydrology improved
- Acres of habitat improved via invasive species removal
- Acres of habitat improved via prescribed burns
- Acres under improved management
- Miles of trails, roads, or campsites improved
- Number of native seedlings propagated
- Pounds of native seeds harvested
- Number of plans developed with stakeholder input

## Risk and Threats to Success

Risk is an uncertain event or condition which, if it occurs, could have a negative effect on an initiative's desired outcome. We reviewed several risk event categories to determine the extent to which they could impede progress towards the Program's restoration strategies and goals.

- **Regulatory Risks**

Actions conducted on federal lands must comply with a variety of federal regulations to ensure proper consideration and evaluation for a number of different factors. In many instances on National Forests, these processes require significant time and coordination to successfully complete and may involve USFWS and NOAA consultation as needed. Depending on the level of complexity, these regulatory risks can alter project(s) timeline and Program momentum. In particular, the National Environmental Policy Act (NEPA) requires evaluation of potential projects for the anticipated and unanticipated outcomes that might arise as a result of their implementation, which adds further complexity to project planning and evaluation tasks.

*Mitigating strategies:* Increase regulatory compliance capacity through the contracting of non-USFS professional experts to prepare regulatory compliance documentation for review by federal agencies. Where appropriate, develop regulatory compliance documents at a programmatic level that address forest wide issues. Coordinate with

USFS to ensure that projects use USFS NEPA-approved techniques referenced in the USFS NEPA handbook when appropriate.

- **Financial Risks**

Funding for this Program comes largely through finite USFS Federal Fire Settlement Funds. Therefore, funding of maintenance and evaluation activities that may be long-term in nature, such as multiple year treatments to ensure invasive species removal, will be under careful consideration. In addition, the designation of the fire settlement funds to projects directly linked to the fire scars may, in some cases, limit the National Forest's capacity to holistically address some issues within watersheds.

*Mitigating strategies:* Identify projects that are expected to accomplish the greatest ecosystem benefit within priority watersheds given the time and resources available. USFS, NFWF, and potentially other partners or consultants will focus on the greatest ecological return on investment by analyzing USFS and NFWF input, each watershed's WCC condition rating, restoration needs, associated costs, and expected outcomes among the watersheds. Where long-term activities are required or geographic focus must be broadened outside of the fire scar or off federal lands, integrate strategies to build additional partnerships and expand sources of funding into future phases of this plan.

- **Environmental Risks**

Environmental risks pose a significant threat to ecosystem restoration on National Forests and watersheds. The threat of uncharacteristic wildfire is ever-present and can potentially negate the gains made through years of recovery implementation. The threat of uncharacteristic wildfire activity can also impact accessibility to the National Forest and reduce opportunities to conduct work. Recently, long-term severe drought in the region has increased stress on vegetation and aquatic communities, and heightened the risk of uncharacteristically intense wildfire activity. Simultaneously, impacts from insect infestation and disease have increased tree mortality, and pose as threats for large landscape level ecosystem change. Additionally, the effects of changing environmental conditions may be influencing a departure from historical conditions towards a "new normal" that are still in transition. As a result, referencing past conditions or statistical trends may not always be appropriate.

*Mitigating strategies:* Select projects based on their ability to reflect the conditions where they are located, and to the extent practical, design projects to account for the potential influence those environmental risks may have on the success of the project. For example, given the high likelihood of fire on California's National Forests, road-stream crossings should be designed to pass water and sediment flows equivalent to expected post-fire events, which may be significantly greater than under "typical" forest conditions. Require that all proposed projects document the potential environmental risks that may influence their activities and expected outcomes, and include options to minimize the impact of those risks to the project. Where appropriate, encourage projects that focus on solutions that adapt to or combat these risks, such as insect infestation and disease. Projects selected for Program funding will be reviewed by a technical advisory group or other qualified reviewers, and projects will be approved, modified, or denied based on these considerations.

- **Information Gaps**

The ability to effectively plan and prioritize activities to direct conservation efforts can be limited on National Forests. Delays could be due to incomplete data on fire and other events' impacts, and lack of resources per each National Forest to adequately investigate the full extent of impacts from fire and other events.

*Mitigating strategies:* Support preliminary assessment and planning projects to help answer key questions, and develop priority recommendations to address critical gaps in information and our understanding of the resource issues. Work with other natural resource managers throughout the region and share information on cause and effect relationships and best practices applicable to expand USFS's capacity to plan and implement sound projects.

- **Social Risks**

Given that National Forests are public lands used by groups with varied interests, the strategies selected by USFS to conduct restoration may not be the preferred approach by all parties. For instance, the proposal of prescribed fire as a management tool may lead to public opposition which could then impact the options and associated costs of management. In addition, the vast size of a National Forest, and limited USFS personnel capacity, means that enforcement of rules and protection of sensitive areas or restoration projects may be challenging at times.

*Mitigating strategies:* Disseminate information to the public about issues related to forest and watershed restoration and the protection of natural resources on the National Forests. As priority actions and projects continue to be identified and refined throughout this Program, budget for and incorporate outreach and education strategies into the project goals to ensure appropriate awareness and discussion among stakeholders. Engage early and often with stakeholders to help resolve issues, clarify rationale, and provide opportunities for discussion and involvement while allowing for flexibility and adaptability of project actions. These activities will also contribute to the long-term support and maintenance of projects on National Forests and their associated watersheds.

- **Institutional Risks**

Insufficient USFS staff capacity may lead to bottlenecks and potentially more limited engagement from USFS employees who already have huge workloads and limited resources to accomplish their assigned tasks.

*Mitigating strategies:* One of the major benefits of this Program comes from the added capacity gained through NFWF staff and establishing partners via grant opportunities. These opportunities can help fill a number of needs including on the ground implementation of projects, assistance with the development of regulatory compliance documents, engineered designs, and sampling and analysis plan development and execution. The Program's grant process helps attract new funding and partners, build networks and relationships, and strengthens the collaboration among all parties interested in the restoration and proper management of California's National Forests and associated watersheds.



## Conclusion

Through this Program, NFWF and USFS will be able to implement a long-term implementation vision that will increase the pace and scale of strategic restoration on unnaturally intense wildfire activity resulting in intense fire-scarred watersheds. Using our Restoration Strategy and NFWF and USFS's expertise, this Program will be able to select and aggregate projects that will provide the greatest return on investment for federal and non-federal investments throughout the northern California region.

## References

- Fiedler, Carnal, and Leidy (1986). Ecological survey of the Green Island Lake proposed research natural area. Unpublished report on file, USFS Pacific Southwest Research Station.
- Loffland (2007). Power Fire California Spotted Owl Habitat Analysis. Unpublished report on file. USFS Eldorado National Forest.
- PCTA (2016). PCT Visit Use Statistics. Pacific Crest Trail Association. <https://www.pcta.org/our-work/trail-and-land-management/pct-visitor-use-statistics/>.
- Roni and Beechie (2012). Stream and Watershed Restoration: A guide to Restoring Riverine Processes and Habitats.
- Sugihara et al (2006). Fire in California's Ecosystems.
- UC Davis, Center for Watershed Sciences & USDA Forest Service, Pacific Southwest Region (2017). Sierra Nevada Multi-Source Meadow Polygons Compilation (v 2.0), Vallejo, CA, Regional Office: USDA Forest Service. <http://meadows.ucdavis.edu/data>
- USDA (2012). USDA California's Forest Products Industry and Timber Harvest, 2012. United States Department of Agriculture.
- USDA (2013). USDA Ecological Restoration Implementation Plan. United States Department of Agriculture.
- USDA (2015). USDA Forest Service Strategic Plan: FY 2015-2020. United States Department of Agriculture.
- USFS (2017a). Phone call on unpublished FY16 Mt. Shasta fee data on file. USFS Shasta-Trinity National Forest.
- USFS (2017b). Land and Resource Management. USFS Region 5 website.
- USFS (2017c). Watershed Condition Framework.
- USFS (2017d). The California Spotted Owl: Current State of Knowledge. USFS Pacific Southwest Research Station.

## Chapter 2 – Watershed Infrastructure Resilience Strategy

### U.S. Forest Service and National Fish and Wildlife Foundation Partnership

In 2018, USFS dedicated \$1 million for strategic restoration projects that will strengthen watershed resilience and associated transportation infrastructure throughout the Pacific Southwest Region. The watershed infrastructure resilience partnership will focus on strengthening watershed ecosystems and function such as fish passage, safeguarding downstream water supplies, improving transportation systems, and enhancing resilience to ecological stressors and disturbances. Select projects are intended to strategically improve watersheds by:

- 1) Increasing fish passage and wildlife habitat accessibility, strengthening watershed and flood control resilience, enhancing water quality, reducing sedimentation, and improving human health and safety. Some of the projects may include:
  - a. Installing, improving, and/or maintaining drainage features such as culverts, drainage dips, and other associated drainage infrastructure, and/or;
  - b. Reducing sedimentation into key watersheds through improving, maintaining, and/or decommissioning transportation infrastructure that have a deleterious impact on watershed health and/or human health and safety; and/or;
- 2) Implementing strategic restoration projects in anticipation to and response to extreme weather and storm events; and/or;
- 3) Maintaining existing motorized transportation infrastructure to increase accessibility to fuels reduction and native vegetation projects.

The watershed infrastructure resilience strategy serves as a guiding document to aid USFS, NFWF, and our partners in focusing and ultimately implementing projects that strategically advance watershed resilience on a larger landscape. Additionally, it integrates and aligns with the Program's larger landscape and watershed-scale Restoration Strategy (NFWF 2018).

The watershed infrastructure strategy outlines the Program's goals and objectives for forest and watershed resilience and highlights potential actions toward reaching those goals. Additionally, working with our tribal partners will be a priority as the Program will integrate cultural and tribal resource protection when applicable. Select National Forests will be targeted in the initial phases of the watershed infrastructure strategy; however projects outside of these areas may be considered in the future depending on funding availability and alignment with the strategic goals of the Program. Collaboration between NFWF and USFS's National Forest Supervisors, District Rangers, and their technical advisory teams will be crucial to the implementation of this strategy.

### *Significance of Transportation Infrastructure Improvements to Watersheds and Aquatic Ecosystems*

Although California's National Forests comprise only 20% of the area in the state, these forests provide nearly half of the state's high quality water supply which all major California metropolitan areas rely on and is worth \$9.5 billion annually (USFS 2017b). California's National Forests are exposed to catastrophic wildfires and extreme weather and storm events which negatively impact transportation infrastructure, decrease water quality, and increase watershed erosion and sedimentation. Damaged

transportation infrastructure and watershed erosion and sedimentation in turn cause water quality, habitat, and migration barriers for aquatic organisms.

Anadromous fish are born in fresh water systems, spend most of their life in ocean/salt water systems, and return to fresh water systems to spawn. Their migratory life cycle is regularly affected by natural and human-caused impacts such as roads, culverts, stream crossings and other instream structures (California Fish Passage Forum 2018a).

Watersheds significantly impacted by erosion of unpaved roads, disconnected streambeds and clogged drainage systems can lead to increased flooding. Unpaved roads are comprised of unpaved aggregate or native surface material and do not have a sealant which holds the surface together. Weather events can easily loosen unpaved road particles and deposit it into nearby watersheds, roads, and drainage systems. Loose particles generally settle in road ditch areas which reduces water carrying capacity and can lead to or exacerbate flooded roads and additional road erosion. Combined, all of this can negatively impact watershed quality and wildlife, in addition to human health and safety (EPA 2000).

Fish passage impediments can impact fish migration, spawning, habitat availability, juvenile and adult fish, and stream functionality. Several state and federal agencies<sup>1</sup> have identified fish passage barriers as a high priority issue in particular for California's anadromous fish populations. Fish passages affect a variety of anadromous species such as the endangered Central California Coast coho salmon, threatened Southern Oregon/Northern California coho salmon, threatened California Coastal Chinook salmon, and threatened or endangered populations of steelhead/coastal rainbow trout (CDFW 2017) (Figure 7). Non-anadromous fish such as the endangered shortnose sucker, threatened green sturgeon, white sturgeon, Pacific lamprey, and lost river sucker are also impacted by fish passage barriers (California Fish Passage Forum 2018a).

Currently there are 15,356 coastal fish passage assessment sites within California, of which 35% or 5,351 are known coastal passage barriers<sup>2</sup> (Figure 8). As of 2013, there were 508 high priority and 236 moderate priority fish passages identified for removal or modification (California Fish Passage Forum 2018b).



Figure 7. Chinook salmon, coho salmon, and steelhead (CDFW).

<sup>1</sup> State and federal agencies involved in the California Fish Passage Forum includes: National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), US Army Corps of Engineers (ACOE), US Fish and Wildlife Service (USFWS), US Forest Service (USFS), California Department of Fish and Wildlife (CDFW), California Department of Transportation (Cal Trans), California Department of Water Resources (DWR), California Natural Resources Agency (CNRA), and California State Coastal Conservancy (CCC).

<sup>2</sup> California Fish Passage Forum's Fish Passage Database at <https://www.cafishpassageforum.org/statewide-barrier-inventory>.

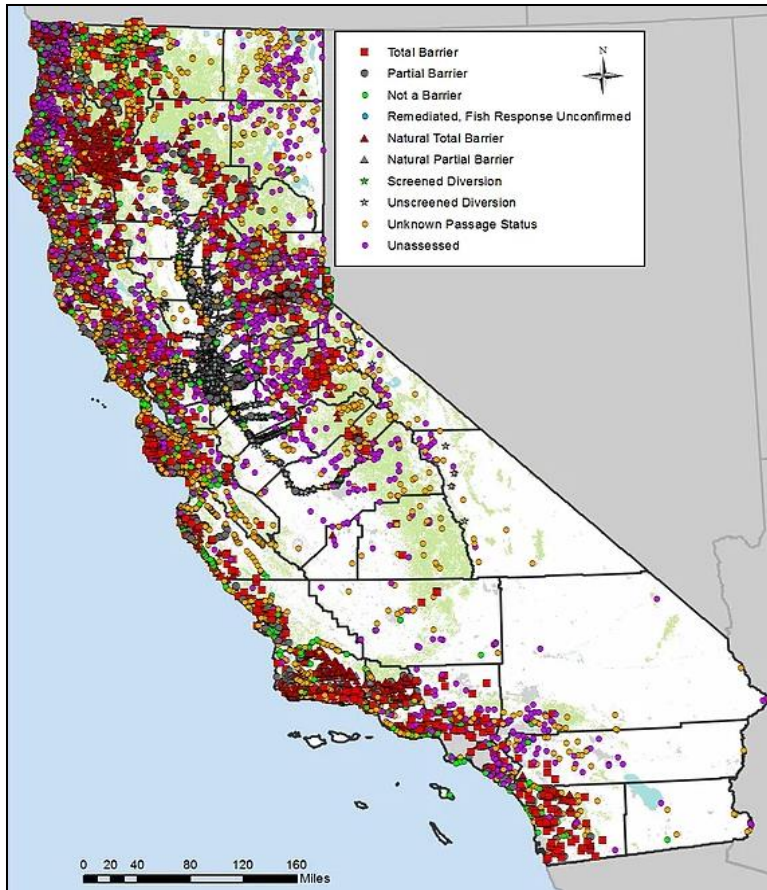


Figure 8. California barrier inventory ([California Fish Passage Forum](#)).

### *Interconnected Relationship between Watersheds and Transportation Infrastructure*

There are a variety of ways that transportation infrastructure improvements can benefit watersheds, water quality, and wildlife. As stated in USDA Forest Service’s National Best Management Practices, “Properly maintained road surfaces and drainage systems can reduce adverse effects to water resources by encouraging natural hydrologic function” (USDA 2012).

USFS’s National Best Management Practices states that routine maintenance is needed for road performance and can include activities such as cleaning out ditches and culverts. However, if routine maintenance is done improperly, “it can also be a source of soil disturbance, concentrated flow, sediment production, and slope instability” (USDA 2012). Therefore, performing necessary road maintenance using watershed improvement focused methods can also reduce sediment loads that enter the watershed. Since a lot of rural, low volume roads are unpaved, they can easily become damaged and increase watershed sediment loads due to wildfires, storm and snow events, road age and frequency of use, or vehicle loads heavier than the road was originally intended. Assessing a road’s usage and maintenance needs can be beneficial to potentially reduce sediment loads entering watersheds.

Erosion plays a role in road maintenance costs due to road surface and ditch disturbances and poor road drainage due to road deterioration. There are a variety of road maintenance techniques available such as cleaning and repairing drainage structures, or re-establishing drainage dips and ditches which will prevent or minimize erosion. Proper road maintenance can lengthen the life of the road surface while also decreasing the amount of sediment carried into nearby watersheds. Frequent and excessive disturbance of the road, ditches, and inability to properly remove water from the road to a drainage system will cause further erosion and deterioration to the road, and can lead to other problems such as traffic flow and safety, and degraded watershed health (EPA 2000).

Prioritizing the removal of fish passage barriers that block habitat is an excellent way to provide historical access to native vegetation and habitat for fish and wildlife. Replacing or improving culverts with fish-friendly culverts would be beneficial for wildlife, watersheds, and the community. Additionally, a culvert could be replaced with a bridge which would provide additional watershed flow, wildlife access, and improve community safety and access.

### *Watersheds and Transportation Infrastructure Benefits*

According to the California Fish Passage Forum (2018a), improving transportation infrastructure and fish passage barriers simultaneously is a cost-effective and highly successful approach that has demonstrated immediate and long lasting ecosystem and human community benefits. This Program will specifically track the following measurable benefits including:

- Number of fish passage barriers improved
- Miles of stream reconnected or improved
- Acres of riparian, meadow, and land habitat improved
- Acres of restored hydrology improved
- Acres under improved management
- Acres of habitat improved through invasive species removal
- Miles of road improved, and,
- Number of plans developed with stakeholder input.

More generally, the immediate and long term ecosystem and human community benefits that California Fish Passage Forum (2018a) has seen are:

#### Fish Populations

- Reduced mortality and predation
- Increased fish migration, habitat, abundance, diversity, and genetic resilience (Figure 9)
- Reduced vulnerability to catastrophic events such as droughts



Figure 9. Before and after photos of a culvert replaced with a fish-friendly culvert ([California Fish Passage Forum](#)).

### Watersheds and Ecosystems

- Improved floodplain functionality and resilience to climate change
- Enhanced connectivity and access to higher quality habitats (Figure 10)
- Reduced downstream erosion and riparian vegetation loss
- Decreased habitat viability for invasive species



Figure 10. Before and after photos of a culvert replaced with a bridge ([California Fish Passage Forum](#)).

### Human Communities

- Enhanced flood control and property protection
- Strengthened public safety via infrastructure improvements (Figure 11)
- Improved groundwater storage and sediment management
- Improved water quality
- Reduced non-point source pollution



Figure 11. Before and after photos of a culvert replaced with a bridge ([California Fish Passage Forum](#)).

California Fish Passage Forum (2018a) has documented several local economic benefits to improving fish passage. They include:

- \$500,000 benefit for each stream mile reconnected
- 12 jobs supported per each stream mile opened to fish passage
- 17 jobs created for every \$1 million invested through increased ecotourism and reduced maintenance costs
- Improved fish passage infrastructure will have limited up-front costs, significant savings, reduced repairs, and will be maintenance free for 50-100 years
- Increased property values near healthy watersheds
- Decreased costs for treating drinking water

## Watershed Infrastructure on the Klamath, Shasta-Trinity, and Six Rivers National Forests

From January through March 2017, USFS experienced extensive storm damage to their roads, trails, infrastructure, and ecosystems in 17 of their 18 California National Forests. Significant wildfires have altered hydrology, erosion, and sedimentation resulting in a need to improve watershed and transportation infrastructure within affected wildfire areas.

Since the fall of 2017, USFS and NFWF have been in discussions to identify select National Forests where key watershed and transportation infrastructure resilience projects could simultaneously occur. USFS has strategically identified three National Forest watersheds that are a high priority for strengthening watershed resilience and transportation infrastructure, ready for resilience implementation, and have completed National Environmental Protection Act (NEPA). The Klamath, Shasta-Trinity, and Six Rivers National Forests were identified as the forests that will have watershed infrastructure funding available in the Northern California Forests and Watersheds Request for Proposals (RFP) (Figure 12). In addition, all of the watershed infrastructure projects would also provide additional protection for human health and safety.

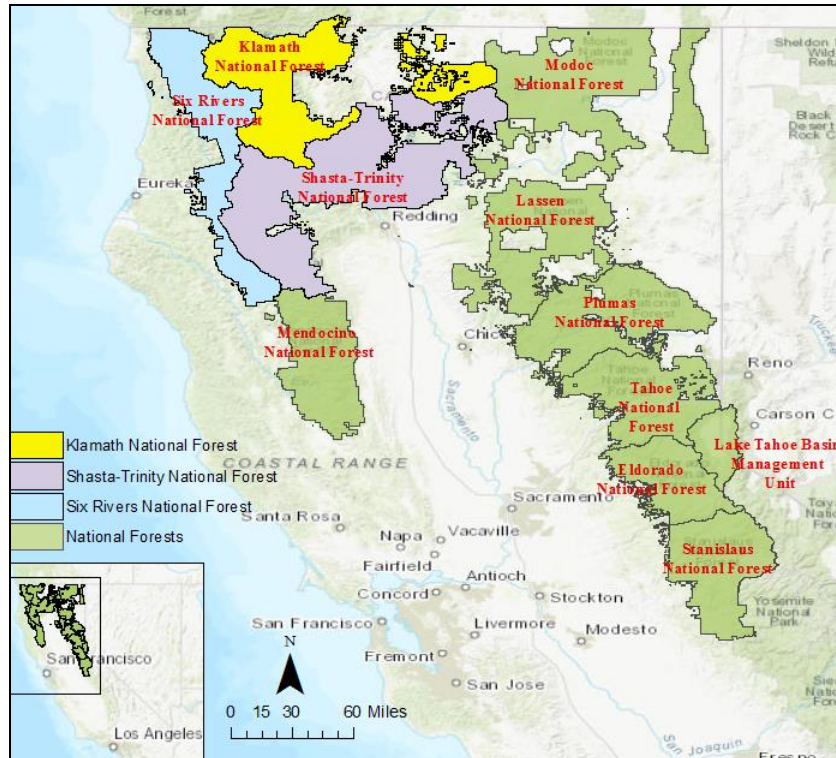


Figure 12. Klamath, Shasta-Trinity, and Six Rivers National Forests were identified for watershed infrastructure funding.

- **Klamath National Forest**

The Klamath National Forest spans nearly 2 million acres across California and Oregon. Over 200 miles of the Klamath, Scott, and Salmon Rivers and their associated tributaries are designated in the National Wild and Scenic Rivers System, which demonstrates that they have outstanding natural, cultural, and recreation values in a free-flowing condition that should be preserved (USFS 2018a).

The Klamath National Forest was selected to have watershed and transportation infrastructure improvements since it is second and third on USFS’s priority aquatic organism passage (AOP) list, has key watersheds that provides high quality water, and is critical habitat for threatened coho salmon, Chinook salmon, steelhead, and Pacific lamprey. Additionally, the Klamath National Forest has been proactive in storm-proofing their transportation infrastructure (USFS 2017c). Fish passage and stream resilience activities would provide increased access to streams for endangered Coho salmon and improve stream functionality (USFS 2017c).

- **Shasta-Trinity National Forest**

The Shasta-Trinity National Forest is the largest National Forest in California at 2.1 million acres. The North and South Forks of the Trinity River spans over 200 miles and are designated in the National Wild and Scenic Rivers System. In particular, the Trinity River has key habitat for threatened coho salmon, Chinook salmon, steelhead, and rainbow trout (USFS 2018a).

The Shasta-Trinity National Forest was selected for watershed and transportation resilience activities since it is on a Top 5 Priority list for both the California Department of Fish and Wildlife



and the California State Water Board. Furthermore, USFS is responsible for 33% of the cost-share road mileage and maintenance, therefore transportation infrastructure improvements will also help lower shared maintenance costs (USFS 2017b).

In particular, improving Parks Creek habitat would benefit occupied Coho salmon habitat. Additionally, the South Fork-Trinity River is one of the few undammed rivers in California and is known for its trophy brown trout, steelhead, and Chinook salmon.

- **Six Rivers National Forest – Smith River National Recreation Area (NRA)**  
The Six Rivers National Forest includes 957,590 acres and manages one of Klamath National Forest’s ranger districts (Ukonom) for a combined total of 1.08 million acres. The Six Rivers National Forest has six rivers including: the Smith, Klamath, Trinity, Mad, Van Duzen and Eel. The Smith, Klamath, Trinity, Eel, and Salmon River are all designated National Wild and Scenic Rivers and total over 365 miles (USFS 2018a).

The Smith River is the only major free flowing river left in California and has over 300 miles of National Wild and Scenic Rivers designation (Rivers 2018). The Smith River National Recreational Area (NRA) is one of 18 federally designated national recreation areas, includes over 358,000 acres, and has key habitat for steelhead, trout, and coho and chinook salmon. Resilience activities within the Smith River NRA would reduce threats to Port-Orford-Cedar which is an endemic conifer, and enhance protections to sensitive plants, water quality, anadromous fish, public safety, and cultural resources (USFS 2017b).

## Northern California Forests and Watersheds Restoration Goals and Priorities

### *Northern California Forests and Watersheds 2018 Request for Proposals*

In 2017, USFS and NFWF engaged in a \$6 million partnership to improve forest and watershed health on the Eldorado and Lassen National Forests through the Program. The Program’s first \$3.34M Request for Proposals (RFP) was released in February 2018 and ended in late March 2018. NFWF received proposals requesting \$3.8M and providing \$2.57M in non-federal match, which is a 67% non-federal match to amount requested ratio.

NFWF worked closely with key staff on the Eldorado and Lassen National Forests to develop a RFP Appendix that had a list of USFS immediate conservation priority projects. Combined, 65% of the Eldorado and Lassen National Forests’ proposals specifically addressed projects identified in the RFP Appendix. The Program’s proposals ranged from a suite of categories including: watershed restoration and management (including AOPs), species management, forest and upland restoration and management, recreation and non-natural features management, and Sierra Nevada meadow restoration and conservation. The Program’s first grant awards of over \$1.64 million were announced in August 2018.

USFS and NFWF anticipate including select watershed and transportation infrastructure resilience projects for the Klamath, Shasta-Trinity, and Six Rivers National Forests into the Northern California Forests and Watersheds Spring 2019 Request for Proposals.

## *Northern California Forests and Watersheds Restoration Goals*

The Program aims to increase the pace and scale of strategic restoration on northern California National Forests. The proposed conservation outcomes of this Program are informed by the USDA Forest Service Strategic Plan (USDA 2015), which identifies two main goals:

- 1) Restore, sustain, and enhance the nation's forests and grasslands by fostering resilient, adaptive ecosystems to mitigate climate change; through strategic land management, mitigating wildfire risk, and conserving open space; and,
- 2) Deliver and sustain the benefits of the National Forests to the American public by providing abundant clean water, strengthening communities, and connecting people to the outdoors. California's National Forests goals are further described and expanded upon within USFS's Ecological Restoration Implementation Plan, and in particular, Chapter 1 - Region 5 Ecological Restoration Leadership Intent, Chapter 2 – Overarching Strategies, and Chapter 3 – National Forest Ecological Restoration Implementation Plan [per National Forest] (USDA 2013).

The Watershed Condition Classification (WCC) is a standardized method used by USFS to evaluate and rate the health and function of watersheds on a number of different attributes (Appendix A). Initial prioritization of watersheds and their related needs may be guided by the available WCC information for each National Forest (USFS 2017d). Watershed Condition Classification information for the select National Forests is available (Appendix D).

## *Northern California Forests and Watersheds Restoration Priorities – A Guide to NFWF Funding*

USFS and NFWF seek to implement a strategic watershed-scale approach to restoration in this region. The initial watershed resilience activities to be completed through this Program are currently supported through USFS funds that are designated to address the impacts and concerns related to transportation infrastructure and watershed impediments. In order to achieve Program goals while operating within the constraints of existing and future funding sources, a variety of separate but complementary strategies and associated activities may be implemented. Some of the Program's highest priority activities include, but are not limited to:

- **Watershed/Aquatic Organism Passage (AOP) Restoration**
  - Site prioritization analysis with restoration recommendations
  - Design planning and watershed/stream assessments e.g.: sedimentation, hydrology, invasive species, vegetation, wildlife, and fish
  - Implementation of watershed restoration/AOP removal projects and NEPA completion
- **Watershed Infrastructure Features and Improvements**
  - Site prioritization analysis with restoration recommendations
  - Design planning for improvements, maintenance, and/or decommissioning of roads and other associated transportation infrastructure, with assessments e.g.: hydrology, sedimentation, vegetation, wildlife, and archaeology
  - Design planning for installation, maintenance, replacement, and/or improvements of bridges and other associated transportation infrastructure, with assessments e.g.: hydrology, sedimentation, vegetation, wildlife, and archaeology

- Design planning for installation, improvements, and/or maintenance of drainage features such as culverts and other associated drainage infrastructure, with assessments e.g.: hydrology, sedimentation, vegetation, wildlife, and archaeology
- Implementation of transportation infrastructure projects and NEPA completion

While the identified priorities above highlight some of the most pressing watershed needs for the Program, the following section describes a full range of strategies and recommendations that may be employed as appropriate. Since USFS has strategically identified high priority National Forest watersheds, the following implementation strategies will now be conducted. As more information is gathered over time, these strategies may be refined to increase success and effectiveness of the Program.

### Strategy 3. Watershed Restoration and Management

Approaches described under this strategy refer to restoration of aquatic environments and the species they support. Aquatic environments include watersheds, meadows, riparian corridors, streams, and fens. Where needed, project activities will be guided by USFS's assessment, prioritization, and planning and cross-referenced to ensure alignment with Program goals and priorities.

- **Aquatic organism passage improvements** - Aquatic organism passage barriers affect some aquatic species by obstructing their distribution and range, reducing available habitat, threatening genetic diversity by isolating populations, increasing the risks from predation and competition, and water quality and quantity impacts. These impacts can be exacerbated even further with increases in pollutant loads and altered habitat after wildfire or other events. Activities may include modifying road and stream crossings to allow unimpeded natural flow such as replacing culverts with a free span bridge, or other means solutions for fish, or other aquatic species, to traverse barriers (USFS 2018b).
- **Instream habitat restoration** - Sediment and debris that enters stream channels and floodplains may dramatically modify the type and distribution of instream habitats throughout the stream network. These impacts may be magnified when anthropogenic influences modify the flow regime and prohibit the natural movement of sediment and other inputs through the system. Instream habitat restoration may include removing or modifying features to enhance downstream sediment transport, restoring floodplain connectivity to streams to disperse sediment from channels, and re-establishing habitat types necessary for various life-cycle stages of aquatic organisms that have been eliminated or diminished as a result of wildfire or other events.
- **Instream flow restoration** - Wildfire may have ramifications to local hydrology, particularly in the meadow and mountain region where over half of California's water supply originates. Changes in soil infiltration rates, evapotranspiration, and overland flows and pathways may all be impacted by post-wildfire events, which can lead to changes in the quantity and timing of instream flows. These changes may in turn directly affect aquatic species that are flow- and habitat-dependent to reach all life history stages. In addition, changes in hydrology have implications for the supply and management of water for human populations that rely on local sources of surface and groundwater. Where these hydrologic alterations are identified and understood, efforts should be made to recover instream flows to conditions supportive of aquatic and riparian species that exist in affected streams. Therefore, instream flow restoration

projects may include but are not limited to projects such as meadow restoration, channel or hydrologic modifications, and debris removal or abatement.

- **Watershed, meadow, fen, and riparian corridor restoration** – Watersheds, meadows, fens, riparian corridors provide a number of ecosystem functions that support both upland and aquatic environments. Streamside vegetation buffers pollutants from waterways, contributes shade and habitat structure for both aquatic and terrestrial species, ameliorates fluctuations in water temperature, reduces instream water temperature, stabilizes stream channel form and function, and can help slow or halt advancing wildfire. However, the loss of meadow and riparian vegetation, and the conversion of meadow and riparian systems from native vegetation to primarily invasive vegetation can alter and degrade these functions in ways that have lasting impact across the landscape. Meadows and riparian corridors will be assessed and restored, where appropriate, to help maintain healthy watersheds and support aquatic-dependent species. Fencing may need to be considered as an option in order to keep out non-native species from sensitive watershed segments, meadows, fens, and riparian habitats. Using fencing strategically may help native vegetation and habitats experience reduced impacts.
- **Invasive species prevention, control, and eradication** - As with the forest and upland environments, aquatic invasive species have established a presence in USFS waterways that threaten the success of native populations. Invasive species may displace, outcompete, or prey on native species and disrupt the ecology of the aquatic and riparian environments. Aquatic invasive plants may affect water availability, nutrient cycling, sediment storage, and flow and flood dynamics. Activities may include removing aquatic vegetation through hand-pulling and mechanical treatment, and localized herbicide application. In the case of invasive species such as mussels and crayfish, eradication may be completed through systematic surveys of the aquatic systems followed by selective capture and eradication (CDFW 2008).

### Strategy 5. Watershed Infrastructure Improvements and Management

Management of watershed infrastructure features such as roads, bridges, culverts, drainage features, and other associated transportation infrastructure play an important role in maintaining healthy landscapes. These features provide critical pathways that allow USFS personnel and other resource managers' critical access to the forest. They also provide an opportunity to connect people with the outdoors and foster appreciation of the natural environment. However, unmaintained and damaged roads, bridges, culverts, and drainage features may exacerbate natural resource challenges by acting as conduits of sediment, invasive species and other impacts. Degraded transportation infrastructure and burned landscapes may also lead to degraded watersheds, increased pollutant sources, and provide new opportunity for the introduction of invasive species. Restoring these features to USFS standards therefore provides multiple benefits to ecosystem restoration and facilitating use and appreciation of public lands.

- **Forest road system management** - Management techniques may include maintenance, improvement, or decommissioning of USFS roads. There is a project preference for USFS roads with critical locations that have chronic erosion and increased sediment loading to watersheds, habitat, or other natural features of the forest. Additionally, there is a preference for USFS roads that can provide critical and enhanced access to native vegetation and fuels reduction management projects. Road maintenance techniques such as adding aggregate surfacing, installing drainage dips to divert water flow across the road, or adding cross drains to transfer

water off the roadway and pipe it under the road for a slower flow discharge are one of several options to reduce sediment loads entering watersheds. Decommissioning USFS roads will also be considered as it can reduce sediment loads, improve water quality, and strengthen environmental and health and human safety.

- **Bridge system management** - Management techniques may include construction, maintenance, replacement, or improvement of bridges. There is a project preference for bridges with critical locations that have chronic erosion and increased sediment loading to watersheds, habitat, or other natural features of the forest and will strongly benefit from stream restoration. Constructing a bridge can enhance stream flow and restoration by increasing the area that water can now pass through, increase disbursement of sediment and debris, and strengthen flood resilience capacity. Additionally, there is a preference for bridges that can provide critical and enhanced access to native vegetation and fuels reduction management projects. Bridge construction may also be utilized if it is a more viable option that is necessary to replace a road and/or culvert system, as it also enhances watershed and flood resilience and public access to the forest.
- **Culvert and drainage feature system management** - Management techniques may include maintenance, replacement, or improvement to culverts and drainage features. There is a project preference for cleaning culverts and drainage features with critical locations that have chronic erosion and increased sediment loading to watersheds, habitat, or other natural features of the forest. Culvert and/or drainage feature installation, maintenance, or enhancement may be utilized if it is a more viable option that is necessary to strengthen watershed and flood resilience. Maintenance techniques such as cleaning culverts and drainage feature systems will also be useful in sediment load reduction, flood control, and enhanced watershed resilience. Other maintenance options include reestablishing effective drainage systems, and installing erosion control materials by armoring culvert outlets with rocks, which will help dissipate energy.

## Measuring Program Performance

The Watershed Strategy is intended to direct actions that result in measureable and beneficial improvement of the resource, and contribute to the goals of the Program. Projects completed through this Program will be required to quantify outcomes that align with the identified priorities. As part of this Program, preliminary metrics will be identified in the RFP to assist resilience outcomes. Preliminary metrics developed for ecological resilience are presented below. These measures may be refined as additional assessment work is completed and priorities are further evaluated.

### Program performance metrics

- Number of fish passage barriers improved
- Miles of stream reconnected or improved
- Acres of riparian, meadow, and land habitat improved
- Acres of restored hydrology improved
- Acres under improved management
- Acres of habitat improved via invasive species removal
- Miles of road improved
- Number of plans developed with stakeholder input

## Conclusion

Through this Program, USFS and NFWF will be able to implement a long-term vision to increase the pace and scale of strategic transportation infrastructure projects to achieve watershed restoration and resilience. Using the Watershed Strategy and USFS and NFWF's expertise, this Program will be able to select and aggregate projects that will provide the greatest return on investment for federal and non-federal investments throughout the northern California region.

## References

- CDFW (2008). California Department of Fish and Wildlife – California Aquatic Invasive Species Management Plan. <https://www.wildlife.ca.gov/Conservation/Invasives/Plan>
- CDFW (2017). California Department of Fish and Wildlife – Fish Conservation. <https://www.wildlife.ca.gov/Conservation/Fishes#>
- California Fish Passage Forum (2018a). [www.cafishpassageforum.org](http://www.cafishpassageforum.org)
- California Fish Passage Forum (2018b). Email on Passage Assessment Database records.
- EPA (2000). A Guideline for Maintenance and Service of Unpaved Roads.
- NFWF (2018). National Fish and Wildlife Foundation and USFS's Northern California Forests and Watersheds Restoration Strategy.
- Rivers (2018). National Wild and Scenic Rivers System. [www.rivers.gov/rivers](http://www.rivers.gov/rivers)
- The Coastal Conservancy (2004). Inventory of Barriers to Fish Passage in California's Coastal Watersheds.
- USDA (2012). National Best Management Practices for Water Quality Management on National Forest System Lands.
- USDA (2013). USDA Ecological Restoration Implementation Plan. United States Department of Agriculture.
- USDA (2015). USDA Forest Service Strategic Plan: FY 2015-2020. United States Department of Agriculture.
- USFS (2017a). Land and Resource Management. USFS Region 5 website. <https://www.fs.usda.gov/detail/r5/landmanagement/?cid=stelprdb5412095>
- USFS (2017b). Water Quality Management. USFS Region 5 website. <https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5352584>
- USFS (2017c). Unpublished briefing paper on priority transportation infrastructure and AOPs. USFS Region 5.
- USFS (2017d). Watershed Condition Framework.
- USFS (2018a). Individual National Forest's website pages for Klamath, Shasta-Trinity, and Six Rivers at [www.fs.usda.gov](http://www.fs.usda.gov)
- USFS (2018b). Aquatic Organism Passage Program. [https://www.fs.fed.us/restoration/Aquatic\\_Organism\\_Passage/index.shtml](https://www.fs.fed.us/restoration/Aquatic_Organism_Passage/index.shtml)

## Appendix A

### Monitoring and Evaluating Performance of Conservation Outcomes Using the USFS Watershed Condition Classification Framework: Review and Summary

#### *Introduction*

The Watershed Condition Classification (WCC) is an approach employed nationally by USFS to evaluate watershed conditions across a variety of attributes, and subsequently aid in the strategic focus of investments in watershed improvement and conservation practices at landscape and watershed scales. This process is intended to help with the systematic and consistent evaluation of watershed conditions and strengthen the effectiveness of USFS to maintain and restore the productivity and resilience of watersheds and their associated aquatic systems on National Forests.

#### *WCC Process*

Watersheds are evaluated at the HUC-6 watershed (12 digit) scale and are described in one of three classes:

1. Class 1 = Functioning Properly
2. Class 2 = Functioning at Risk
3. Class 3 = Impaired Function

The WCC consists of 12 watershed condition indicators. These 12 indicators are grouped and weighted to represent four general processes that drive watershed function: Aquatic Physical Processes (Weight = 30%), Aquatic Biological Processes (Weight = 30%), Terrestrial Physical Processes (Weight = 30%), and Terrestrial Biological Processes (Weight = 10%).

Each indicator contains one or more attributes which are assigned a numeric score to reflect the relative condition of that attribute for the watershed being evaluated. Attributes are scored as 1 (Good), 2 (Fair), 3 (Poor). Attribute scores are then summed and averaged to produce the score representative of that indicator.

The indicator scores are assigned based on criteria provided in the WCC Technical Guide (USFS 2017c). Depending on the attribute, scoring criteria may be numeric, descriptive, or GIS-based in nature. In particular, the descriptive attributes are qualitative or semi-quantitative variables subject to some degree of interpretation by users. The WCC process, regardless of the scoring criteria, is intended to serve as a diagnostic tool to promote discussion and understanding about of relative watershed conditions. It relies on local professional expertise and judgment from an interdisciplinary team, GIS data, national databases to the extent they are available, and written criteria, referred to as a “rule set” for proper evaluation and interpretation. Indicators and attributes used in the WCC process are described at the end of this memo.

The goal of the process is to use the best available information and data to assess the ecological conditions of the watersheds of interest. As such, the WCC allows flexibility for the adjustment of attributes depending on local knowledge and/or applicability of the criteria to local physiographic settings. Attributes may be adjusted through modification of the default ranges, substitution of higher quality data, or assigned a value of Not Applicable (if appropriate). Only two indicators (Forest cover and Rangeland vegetation) and two attributes (Large woody debris and Mass wasting) may be rated N/A subject to USFS Regional Oversight Team approval.

## ***Use of the WCC for Monitoring and Evaluation in the Northern California Forests and Watersheds Program***

The WCC approach appears to align well with the goals of the Northern California Forests and Watersheds Program. The primary goal of the Program is to restore and improve forests and watersheds by increasing ecosystem integrity and resilience. The WCC identifies and addresses the major factors that influence watershed health and reviews those factors independently and collectively. Although it was designed to support initial assessments of watershed health to inform priority setting and restoration planning, it can be modified to evaluate and monitor how those factors change in response to restoration actions over time.

The WCC provides flexibility to adapt and refine the metrics by which those factors are evaluated to best represent the geographies and local conditions of the watersheds being reviewed. As such, NFWF plans to use the WCC as the foundation for a monitoring and evaluation plan to track and monitor Program activities and outcomes over time. NFWF will work to integrate the WCC, as needed, so that it satisfies the management goals of both USFS and NFWF and can be applied in other National Forests where similar work is occurring.

### ***WCC Rating Metrics (Indicators most relevant to the Northern California Forests and Watersheds Program denoted with \*):***

1. Aquatic Physical Process
  - a. **Water quality indicator**
    - i. *Impaired waters (303d listed)* – Criteria: % of stream miles/lake area listed on 303d or 305b lists
    - ii. *Water quality problems* – Criteria: Qualitative judgment of non-listed water quality issues
  - b. **Water quantity indicator**
    - i. *Flow characteristics* – Criteria: Qualitative judgement on departure from natural hydrograph regime
  - c. **Aquatic habitat indicator**
    - i. \* *Habitat fragmentation* – Criteria: % of connectivity among historic aquatic habitats
    - ii. *Large woody debris (LWD)* – Criteria: Qualitative judgment on presence/absence of LWD recruitment based on expectations for that system
    - iii. \* *Channel shape and function* – Criteria: % of width/depth ratios and channel entrenchment displaying increase from expected conditions
2. Aquatic Biological Process
  - a. **Aquatic biota indicator**
    - i. \* *Life form presence* – Criteria: % of expected aquatic life form and communities present
    - ii. \* *Native species* – Criteria: Qualitative judgement of presence and self-sustaining populations of native species
    - iii. \* *Exotic and/or invasive aquatic species* – Criteria: % of historic native aquatic life-bearing habitats with exotic/invasive species present, and trends in expansion
  - b. **Riparian/Wetland vegetation indicator**
    - i. \* *Vegetation condition* – Criteria: % of native vegetation presence and success
3. Terrestrial Physical Process
  - a. **Roads and trails indicator**
    - i. *Open road density* – Criteria: road/trail density (mi/mi<sup>2</sup>)
    - ii. \* *Road and trail maintenance* – Criteria: % of roads/trail displaying appropriate BMPs



- iii. \* *Proximity to water* – Criteria: % of road/trail length within 300 feet of streams/waterbodies, or hydrologically connected to them
  - iv. \* *Mass wasting* – Criteria: Qualitative judgment of road/trail stability and potential for delivery to stream channel
- b. Soils indicator**
- i. *Soil productivity* – Criteria: % soil and hydrologic cycling process functioning normally throughout the watershed
  - ii. \* *Soil erosion* – Criteria: % of watershed displaying evidence of accelerated surface erosion
  - iii. *Soil contamination* – Criteria: Qualitative judgment of areas of soil contamination, and atmospheric deposition related to terrestrial critical load
4. Terrestrial Biological
- a. Fire regime or wildfire indicator**
- i. \* *Fire regime condition class* – Criteria: Fire Regime Condition Class rating (USFS)
  - ii. *Wildfire effects* – Criteria: Qualitative judgment on expected recovery of soil and ground cover conditions
- b. Forest cover indicator**
- i. \* *Loss of forest cover* – Criteria: % of NFS land with cut-over, denuded, or deforested forest cover in relation to desired/expected conditions
- c. Rangeland vegetation indicator**
- i. \* *Rangeland vegetation condition* – Criteria: Qualitative judgment of annual plant production in comparison to production potential and condition
- d. Terrestrial invasive species indicator**
- i. \* *Extent and rate of spread* – Criteria: % of watershed with established terrestrial invasive species and qualitative judgment of potential impact and rate of spread
- e. Forest health**
- i. \* *Insects and disease* – Criteria: % of forested land in watershed at risk of abnormally high levels of tree mortality
  - ii. *Ozone* – Criteria: % of years evaluated where ozone causes decrease in biomass

## Appendix B

### Watershed Condition Classification (WCC) for Fire Affected Watersheds

#### Eldorado National Forest - Power Fire watersheds

Watersheds	Impaired Function (Level 3 - Poor) Indicator Categories	Functioning at Risk (Level 2 - Fair) Indicator Categories
<b>Bear River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems (not listed)</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>
<b>Cole Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>
<b>Panther Creek</b>	<ul style="list-style-type: none"> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Soils</b> – soil productivity, soil erosion, soil contamination</li> </ul>
<b>Salt Springs Reservoir – North Fork Mokelumne River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> </ul>

<b>Tiger Creek – North Fork Mokelumne River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> </ul>
---	---	--

### Eldorado National Forest - CFLR watersheds

Watersheds	Impaired Function (Level 3 - Poor) Indicator Categories	Functioning at Risk (Level 2 - Fair) Indicator Categories
<b>Cat Creek – Middle Fork Cosumnes River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> </ul>
<b>Sopiago Creek – Middle Fork Cosumnes River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> </ul>

### Lassen National Forest - Storrle Fire watersheds

Watersheds	Impaired Function (Level 3 - Poor) Indicator Categories	Functioning at Risk (Level 2 - Fair) Indicator Categories
<b>Chips Creek</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> </ul>
<b>Colby Creek – Butte Creek</b>	<ul style="list-style-type: none"> <li>• <b>Forest health</b> – insects and disease, ozone</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>
<b>Last Chance Creek – West Branch Feather River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> </ul>
<b>Lower Yellow Creek</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>
<b>Milk Ranch Creek – North Fork Feather River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Soils</b> – soil productivity, soil erosion, soil contamination</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems (not listed)</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>

<p><b>Mosquito Creek – North Fork Feather River</b></p>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems (not listed)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>
<p><b>Rock Creek</b></p>	<ul style="list-style-type: none"> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>
<p><b>Upper Yellow Creek</b></p>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Roads and trails</b> – open road density, road and trail maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> </ul>

## Appendix C Threatened, Endangered, and USFS Sensitive Plant and Animal Species

### Eldorado National Forest

#### Threatened and Endangered Species throughout the entire Eldorado National Forest

Species	Scientific Name	Federal Status	Critical Habitat on ENF
<b>Amphibians</b>			
California red-legged frog	<i>Rana aurora draytonii</i>	Threatened	Yes
Sierra Nevada yellow-legged frog	<i>Rana sirrae</i>	Endangered	Yes
Yosemite toad	<i>Anaxyrus canorus</i>	Threatened	Yes
<b>Plants</b>			
Layne's butterweed	<i>Packera layneae</i>	Threatened	None Designated
Whitebark pine	<i>Pinus albicaulis</i>	Candidate	None Designated

#### USFS Sensitive Animals and Plants Species throughout the entire Eldorado National Forest

Species	Scientific Name
<b>Amphibian</b>	
Foothill yellow-legged frog	<i>Rana boylei</i>
<b>Birds</b>	
Bald eagle	<i>Haliaeetus leucocephalus</i>
California spotted owl	<i>Strix occidentalis occidentalis</i>
Great gray owl	<i>Strix neulosa</i>
Northern goshawk	<i>Accipiter gentilis</i>
Willow flycatcher	<i>Empidonax trailii</i>
<b>Fish</b>	
Hardhead	<i>Mylopharodon conocephalus</i>
Pacific lamprey	<i>Entosphenus tridentatus</i>
<b>Fungi</b>	
Branched collybia	<i>Dendrocollybia racemosa</i>
Olive phaeocollybia	<i>Phaeocollybia olivacea</i>
<b>Mammals</b>	
American marten	<i>Martes Americana</i>
Fringed myotis	<i>Myotis thysanodes</i>
Pacific fisher	<i>Martes pennanti</i>
Pallid bat	<i>Antrozous pallidus</i>
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>
Wolverine	<i>Gulo gulo</i>
<b>Reptiles</b>	
Western pond turtle	<i>Emys marmorata</i>

<b>Terrestrial invertebrates</b>		
Western bumble bee	<i>Bombus occidentalis</i>	
		<b>CNPS STATUS</b>
<b>Lichens</b>		
Veined water lichen	<i>Peltigera gowardii</i>	4.2
		<b>CNPS STATUS</b>
<b>Plants</b>		
Adder's tongue	<i>Ophioglossum pusillum</i>	2B.2
Big-scale balsamroot	<i>Balsamorhiza macrolepis</i> var. <i>macrolepis</i>	1B.2
Blandow's bog-moss	<i>Helodium blandowii</i>	2B.3
Bolander's bruchia	<i>Bruchia bolanderi</i>	4.2
Broad-nerved hump-moss	<i>Meesia uliginosa</i>	2B.2
Common moonwort	<i>Botrychium lunaria</i>	2B.3
Cup Lake draba	<i>Draba asterophora</i> var. <i>macrocarpa</i>	1B.1
El Dorado manzanita	<i>Arctostaphylos nissenana</i>	1B.2
Elongate copper moss	<i>Mielichhoferia elongata</i>	4.3
Hutchison's lewisia	<i>Lewisia kelloggii</i> ssp. <i>hutchisonii</i>	3.2
Kellogg's lewisia	<i>Lewisia kelloggii</i> ssp. <i>kelloggii</i>	3.2
Long-petaled lewisia	<i>Lewisia longipetala</i>	1B.3
Mingan moonwort	<i>Botrychium minganense</i>	2B.2
Mountain lady's slipper	<i>Cypripedium montanum</i>	4.2
Mountain moonwort	<i>Botrychium montanum</i>	2B.1
Paradox moonwort	<i>Botrychium paradoxum</i>	2B.1
Parry's horkelia	<i>Horkelia parryi</i>	1B.2
Pleasant Valley mariposa lily	<i>Calochortus clavatus</i> var. <i>avius</i>	1B.2
Saw-toothed lewisia	<i>Lewisia serrata</i>	1B.1
Scalloped moonwort	<i>Botrychium crenulatum</i>	2B.2
Sierra blue grass	<i>Poa sierrae</i>	1B.3
Stalked moonwort	<i>Botrychium pedunculosum</i>	2B.1
Stebbins' phacelia	<i>Phacelia stebbinsii</i>	1B.2
Tahoe draba	<i>Draba asterophora</i> var. <i>asterophora</i>	1B.2
Three-bracted onion	<i>Allium tribracteatum</i>	1B.2
Tripod buckwheat	<i>Eriogonum tripodum</i>	4.2
Upswept moonwort	<i>Botrychium ascendens</i>	2B.3
Yellow bur navarretia	<i>Navarretia prolifera</i> ssp. <i>lutea</i>	4.3
Yellow-lip pansy monkeyflower	<i>Mimulus pulchellus</i>	1B.2

**California Native Plant Society (CNPS) Status codes:**

- 1A = Plants Presumed Extirpated in CA and Either Rare or Extinct Elsewhere
- 1B = Plants Rare, Threatened, or Endangered in CA and Elsewhere
- 2A = Plants Presumed Extirpated in CA, But Common Elsewhere
- 2B = Plants Rare, Threatened, or Endangered in CA, But More Common Elsewhere
- 3 = Plant Status That Requires More Information
- 4 = Plants of Limited Distribution – A Watch List

**Threat Ranks:**

- 0.1 – Seriously Threatened in CA (>80% of occurrences threatened/high degree and immediacy of threat)
- 0.2 – Moderately Threatened in CA (20 – 80% of occurrences threatened/moderate degree and immediacy of threat)
- 0.3 – Not Very Threatened in CA (less than 20% of occurrences threatened/low degree and immediacy of threat or no current threats known)

## Lassen National Forest

### Threatened and Endangered Species throughout Lassen National Forest's Storrie Fire watersheds

Species	Scientific Name	Federal Status	Critical Habitat on LNF
<b>Amphibians</b>			
Sierra Nevada yellow-legged frog	<i>Rana sierrae</i>	Endangered	Yes

### USFS Sensitive Animals and Plants Species throughout Lassen National Forest's Storrie Fire watersheds

Species	Scientific Name	CNPS STATUS
<b>Amphibians</b>		
Cascade frog	<i>Rana cascadae</i>	
<b>Birds</b>		
Bald eagle	<i>Haliaeetus leucocephalus</i>	
California spotted owl	<i>Strix occidentalis</i>	
Great gray owl	<i>Strix nebulosa</i>	
Greater sandhill crane	<i>Grus Canadensis fabida</i>	
Northern goshawk	<i>Accipiter gentilis</i>	
Willow flycatcher	<i>Empidonx traillii</i>	
<b>Fish</b>		
Pacific lamprey	<i>Entosperus tridentatulus</i>	
<b>Mammals</b>		
Fringed myotis	<i>Myotis thysanodes</i>	
North American wolverine	<i>Gulo luscus</i>	
Pacific fisher	<i>Martes pennanti pacifica</i>	
Pacific marten	<i>Martes caurina</i>	
Pallid bat	<i>Antrozous pallidus</i>	
Sierra Nevada red fox	<i>Vulpes necator</i>	
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	
<b>Terrestrial invertebrates</b>		
Western bumble bee	<i>Bombus occidentals</i>	
<b>Plants</b>		
Blandow's bog moss	<i>Helodium blandowii</i>	2B.3
Bolander's bruchia	<i>Bruchia bolanderi</i>	4.2
Broad-nerved hump moss	<i>Meesia uliginosa</i>	2B.2
Caribou coffeeberry	<i>Frangula purshiana ssp. ultramafica</i>	1B.2
Clifton's eremogone	<i>Eremogone cliftonii</i>	1B.3
Clustered lady's slipper	<i>Cypripedium fasciculatum</i>	4.2
Common moonwort	<i>Botrychium lunaria</i>	2B.3
Constance's rock cress	<i>Boecheera constancei</i>	1B.1
Cut-leaved ragwort	<i>Packera eurycephala var. lewisrosei</i>	1B.2
Feather River stonecrop	<i>Sedum albomarginatum</i>	1B.2



Follett's monardella	<i>Monardella follettii</i>	1B.2
Green bug-on-a-stick	<i>Buxbaumia viridis</i>	2B.2
Hutchison's lewisia	<i>Lewisia kelloggii</i> ssp. <i>hutchisonii</i>	3.2
Long-stiped campion	<i>Silene occidentalis</i> ssp. <i>longistipitata</i>	1B.2
Mildred's clarkia	<i>Clarkia mildrediae</i> ssp. <i>mildrediae</i>	1B.3
Mingan moonwort	<i>Botrychium minganense</i>	2B.2
Northwestern moonwort	<i>Botrychium pinnatum</i>	2B.3
Plumas aster	<i>Oreostemma elatum</i>	1B.2
Scalloped moonwort	<i>Botrychium crenulatum</i>	2B.2
Sierra bluegrass	<i>Poa sierrae</i>	1B.3
Stalked moonwort	<i>Botrychium pedunculosum</i>	2B.1
Upswept moonwort	<i>Botrychium ascendens</i>	2B.3
Western goblin	<i>Botrychium montanum</i>	2B.1

**California Native Plant Society (CNPS) Status codes:**

- 1A = Plants Presumed Extirpated in CA and Either Rare or Extinct Elsewhere
- 1B = Plants Rare, Threatened, or Endangered in CA and Elsewhere
- 2A = Plants Presumed Extirpated in CA, But Common Elsewhere
- 2B = Plants Rare, Threatened, or Endangered in CA, But More Common Elsewhere
- 3 = Plant Status That Requires More Information
- 4 = Plants of Limited Distribution – A Watch List

**Threat Ranks:**

- 0.4 – Seriously Threatened in CA (>80% of occurrences threatened/high degree and immediacy of threat)
- 0.5 – Moderately Threatened in CA (20 – 80% of occurrences threatened/moderate degree and immediacy of threat)
- 0.6 – Not Very Threatened in CA (less than 20% of occurrences threatened/low degree and immediacy of threat or no current threats known)

## Appendix D

### Watershed Condition Classification (WCC) for Watershed and Transportation Infrastructure Affected Watersheds

#### Klamath National Forest

Subwatersheds (HUC-6)	Impaired Function (Level 3 - Poor) Indicator Categories	Functioning at Risk (Level 2 - Fair) Indicator Categories
<b>Canyon Creek</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Horse Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Kelsey Creek</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Olsen Creek – North Fork Salmon River</b>	<ul style="list-style-type: none"> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>

## Shasta-Trinity National Forest

Subwatersheds (HUC-6)	Impaired Function (Level 3 - Poor) Indicator Categories	Functioning at Risk (Level 2 - Fair) Indicator Categories
<b>Barker Creek – Hayfork Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Corral Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Dubakella Creek – Hayfork Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>East Fork Hayfork Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>East Fork New River</b>	<ul style="list-style-type: none"> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> </ul>

		<ul style="list-style-type: none"> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Eltapom Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Happy Camp Creek – South Fork Trinity River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Little Bear Wallow Creek – South Fork Trinity River</b>	<ul style="list-style-type: none"> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>McDonald Creek – Trinity River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Olsen Creek – Hayfork Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest cover</b> – loss of forest cover</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Parks Creek</b>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>

<b>Pelletreau Creek – South Fork Trinity River</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Rattlesnake Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> </ul>
<b>Salt Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> <li>• <b>Water quantity</b> – flow characteristics</li> </ul>
<b>Smoky Creek – South Fork Trinity River</b>	<ul style="list-style-type: none"> <li>• <b>N/A</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Tule Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Rangeland vegetation</b> – rangeland vegetation condition</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Upper Browns Creek</b>	<ul style="list-style-type: none"> <li>• <b>N/A</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class or wildfire effects</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>

		<ul style="list-style-type: none"> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>
<b>Upper Willow Creek</b>	<ul style="list-style-type: none"> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Forest health</b> – insects and disease, ozone</li> <li>• <b>Water quality</b> – impaired waters (303(d) listed), water quality problems</li> </ul>

**Six Rivers National Forest  
Smith River National Recreation Area**

<b>Subwatersheds (HUC-6)</b>	<b>Impaired Function (Level 3 - Poor) Indicator Categories</b>	<b>Functioning at Risk (Level 2 - Fair) Indicator Categories</b>
<b>Diamond Creek</b>	<ul style="list-style-type: none"> <li>• <b>Forest cover</b> – loss of forest cover</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> </ul>
<b>Hardscrabble Creek (Myrtle) – Smith River</b>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Lower Middle Fork Smith River</b>	<ul style="list-style-type: none"> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> <li>• <b>Terrestrial invasive species</b> – extent and rate of spread</li> </ul>
<b>Lower North Fork Smith River</b>	<ul style="list-style-type: none"> <li>• <b>Forest cover</b> – loss of forest cover</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> </ul>
<b>Rowdy Creek</b>	<ul style="list-style-type: none"> <li>• <b>Aquatic biota</b> - life form presence, native species, exotic and/or aquatic invasive species</li> <li>• <b>Fire regime or wildfire</b> – fire regime condition class, wildfire effects</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aquatic habitat</b> – habitat fragmentation, large woody debris, channel shape and function</li> <li>• <b>Riparian/wetland vegetation</b> – vegetation condition</li> <li>• <b>Roads</b> – open road density, road maintenance, proximity to water, mass wasting</li> </ul>